

**Anchorage  
Port Intermodal Expansion Program (PIEP)**

**Benefit Cost Analysis of  
Proposed TIGER Discretionary Grant Funds**

by

Scott Goldsmith and Tobias Schwoerer

Prepared for

**The Port of Anchorage**

September 4, 2009



Institute of Social and Economic Research  
University of Alaska Anchorage  
3211 Providence Dr  
Anchorage AK 99508  
907-786-7720  
[www.iser.uaa.alaska.edu](http://www.iser.uaa.alaska.edu)

**Anchorage  
Port Inter-modal Expansion Program (PIEP)**

**Benefit Cost Analysis of  
Proposed TIGER Discretionary Grant Funds**

**Table of Contents**

1. Introduction.....	1
2. Executive Summary .....	2
3. Methodology .....	6
4. Benefit Calculation .....	8
4.a. Capacity Expansion .....	8
4.b. Reduced Life Cycle Costs .....	16
4.c. Enhanced Operating Efficiencies .....	17
4.d. Reduced CO2 and Other Emissions .....	18
5. Cost Calculation .....	20
6. Results.....	21
7. Sensitivity Analysis .....	23
7.a. Model Assumptions .....	23
7.b. Project Cost.....	24
7.c. Special Large Projects .....	26
7.d. Discount Rate.....	26
7.e. Earthquake Risk Reduction.....	26
8. Other Benefits Not Quantified .....	29
8.a. Economic Competitiveness .....	29
8.b. Environmental Benefits .....	31
References .....	33
Appendix: Excel Workbook .....	36

# 1. Introduction

The Port of Anchorage (POA) has exceeded its design life and has been operating beyond its capacity for a number of years. It is in need of replacement to both minimize operating costs and avoid potential damage in the event of an earthquake. It is in need of expansion to meet the needs of the growing South Central Alaska economy<sup>1</sup>. In response to these needs the POA has embarked on a multi-year expansion project—the Port Inter-modal Expansion Program (PIEP)<sup>2</sup>.

In early 2009, in the midst of this expansion program, the federal government passed the American Recovery and Reinvestment Act. The Recovery Act appropriated \$1.5 billion of discretionary funds to be awarded by the Department of Transportation for capital investments in surface transportation infrastructure (including ports) that would provide long-term economic benefits as well as preserve and create jobs and promote economic recovery<sup>3</sup>.

In support of its request for a “Grant for Transportation Investment Generating Economic Recovery” (TIGER Grant), the POA asked the Institute of Social and Economic Research (ISER) to prepare a Benefit-Cost Analysis (BCA) demonstrating the long term economic benefits that would flow from expenditure of grant funds in support of the PIEP.

This BCA follows the guidelines set forth in the Federal Register notice announcing the TIGER grant program. It measures the increase in national income that would result from the expenditure of the grant funds in support of the PIEP. Since the POA funding request would pay only a portion of the cost of the entire PIEP, this BCA is limited to measuring the benefits from the expenditure of the TIGER grant funds rather than the total benefits of the entire PIEP.

---

<sup>1</sup> POA (Port of Anchorage). 2005. Marine Terminal Redevelopment Environmental Assessment, EIS. VZM (Vickerman Zachary Miller/ Transsystems). 1999. Regional Port of Anchorage Master Plan

<sup>2</sup> Described in POA (Port of Anchorage). 2005. Marine Terminal Redevelopment Environmental Assessment, EIS

<sup>3</sup> Federal Register. 2009. Notice of Funding Availability for Supplemental Discretionary Grants for Capital Investments in Surface Transportation Infrastructure under the American Recovery and Reinvestment Act/Vol. 74, No. 115 /Wednesday, June 17, 2009 /Notices, page 28755-28767.

## 2. Executive Summary

The Benefit-Cost Analysis (BCA) quantifies the long term economic benefits from the expenditure of \$227 million of TIGER grant funds as part of the Port of Anchorage Inter-modal Expansion Program (PIEP). It does not include the short term job creation and economic stimulus benefits that would also flow from the TIGER grant expenditure. Conservatively estimated, the benefit to cost ratio (B/C) is 2.5 which means that each dollar of TIGER grant expenditure increases net national income by \$2.50.

The BCA follows the guidelines established in OMB Circular A-94 such that only benefits that increase net national income are included, and benefits and costs between 2010 and 2029 are discounted to a net present value in 2009 at a 7% real discount rate. The benefits of \$527 million are the cost savings that the port, shippers, and consumers of shipping services would experience with the expanded port facilities compared to continued use of the port without those enhanced facilities. (Reduced CO2 emissions valued at \$18.8 million are also included in the total benefits.) The costs are the \$227 million of TIGER funding.

With the exception of an attribution of the value of reduced co2 emissions (\$33 per ton) all benefit quantities are based on actual cost information from the port, shippers, and other published sources.

The TIGER grant request covers only a portion of the total PIEP development budget that would be used to complete the North Extension and the South Extension components of the PIEP. Consequently the BCA measures only those benefits that can reasonably be attributable to that part of the total port development. Because of the complex phasing of the overall port expansion, completion of the North Extension is a necessary antecedent for the construction of the North Replacement. Thus although stimulus funding would not directly pay for completion of the North Replacement--the future location of the container dock--without stimulus funding the North Replacement could not proceed. Therefore the analysis includes the benefits from the North Replacement and the South Extension.

TIGER grant expenditures would create benefits in all 5 benefit categories identified in the TIGER grant application guidelines. Table 2.1. shows the quantifiable benefits total \$527 million. The port would have reduced maintenance costs from elimination of the need to replace deteriorating piles. Shippers would have reduced transport costs because they would be able to replace their existing container ships with larger capacity “stretched” vessels that use only marginally more fuel to move significantly more cargo (reducing the unit cost per container). Alaska businesses and households would save shipping costs because the expanded port would eliminate existing capacity constraints for handling both containers and petroleum that result in a growing diversion of freight to other more costly ports and transit modes.

**Table 2.1. Long Term Economic Benefits Quantified in Benefit Cost Analysis**

Long Term Outcome (TIGER Application Benefit Category)	Quantified Benefit Category	Cumulative Benefits 2010-2029 (Million 2009 \$)	
		Total	Present Value in 2009 Discounted at 7%
<b>TOTAL</b>		<b>\$1,112</b>	<b>\$527</b>
(i) State of Good Repair	Reduction in annual maintenance cost to port (life cycle costs)	\$138	\$87
(ii) Economic Competitiveness	Access by larger container ships reduces shipper cost	\$103	\$56
(iii) Livability	Enhancement of port capacity reduces business and household costs	\$871	\$383
(iv) Sustainability	*	-	-
(v) Safety	**	-	-

\* Value of reduced fuel consumption and CO2 emissions included in outcomes (ii) and (iii).

\*\* Value of reduced loss in the event of an earthquake included as a sensitivity analysis.

Comparing the \$527 million of benefits to the present value of the proposed TIGER grant results in a B/C ratio of 2.5 using a discount rate of 7%. If we subtract the costs from the benefits, the net present value is \$319 million.

**Table 2.2. The Benefit Cost Ratio Calculation (Million 2009 \$)**

(a) Long Term Economic Benefits	\$527
(b) Project Cost *	\$208
Net Present Value (a-b)	\$319
<b>Benefit / Cost Ratio (a/b)</b>	<b>2.5</b>

\* Project Expenditures that would occur in 2010 and 2011 are discounted to 2009.

The quantified benefits were estimated conservatively, taking into account only the most easily quantifiable cost savings in each category. For example, the benefit from larger container ships was measured as the savings in fuel and shipboard labor (minus the capital cost to “stretch” the ships) and did not take into account savings in shore based labor costs. The savings in port maintenance costs did not include savings associated with more energy efficient container cranes.

Long term benefits were identified in 8 additional general categories (Table 2.3.) but uncertainty in attributing those benefits to the part of the port expansion funded by the TIGER grant, as well as difficulties in quantifying benefits and monetizing them, prevented them from being included in the BCA calculation. For example, port expansion enhances the response capabilities of the military in Alaska, but estimation of the military willingness to pay for that capability was beyond the scope of the analysis. Also, estimating the additional national income that would result from a more competitive Alaskan economy was not done.

**Table 2.3. Additional Long Term Economic Benefits Not Quantified for Benefit Cost Analysis**

Long Term Outcome	Port Development Benefit Category
(ii) Economic Competitiveness	Enhanced military preparedness
“	Reduced costs for Alaska residents and businesses
“	Reduced transport cost for special projects
“	New economic initiatives: Cruise Ships
“	New economic initiatives: Conbulk Backhaul
(iii) Livability	Reduced highway congestion
(iv) Sustainability	Reduced carbon monoxide and water pollutants
(v) Safety	Reduced highway accidents, personal injuries, and deaths

The B/C ratio of 2.5 is not sensitive to changing assumptions about fuel price, cost of CO2 emissions, or Alaska petroleum production. It is sensitive to the assumption of annual growth in tonnage over the port, which has been set at 2.5% based on actual historical experience. However, even if this growth rate assumption were reduced to 1% annually, the B/C ratio would only fall to 1.7. Conversely if the growth rate were to average 5%, the B/C ratio would increase to 5.9. The B/C ratio varies from 2.0 to 3.6 if the discount rate is varied between 10 percent and 3 percent.

The B/C would be 3.2 if the affect of large project shipping demand (a gas pipeline and mining developments) is included. Based on a probability analysis, assuming that a major earthquake might occur in the next 20 years would not change the B/C ratio.

The B/C would be lower—between 1.4 and 1.8--if the costs were defined to include the entire PIEP budget (including non TIGER grant fund sources). Finally, even if only half the quantified benefits of \$527 million were are attributed to the TIGER grant, the B/C ratio would still be 1.3.

### 3. Methodology

The Benefit Cost Analysis (BCA) is a comparison of the costs to society if the requested TIGER grant funds were spent on port upgrades (BUILD SCENARIO) compared to a NO BUILD SCENARIO in which the existing port continues to be used because non TIGER grant funding is insufficient to move the Port Inter-modal Expansion Program (PIEP) forward. (The entire program would need to be downsized.) The primary effect of the port upgrades would be to reduce the economic resources required to ship goods into South Central Alaska. The BCA measures this cost reduction, which represents a real increase in national income. Two additional categories of benefits are discussed in this paper, but with the exception of CO<sub>2</sub> and other emissions, not quantified for the formal analysis. These additional categories are environmental benefits and economic development benefits. These categories have been excluded because the resources available for this study were limited and these benefits are more difficult to measure because the absence of market prices makes it difficult to quantify them.

The benefits from the BUILD SCENARIO compared to the NO BUILD SCENARIO are quantified for a 20 year period from 2010 through 2029 in real 2009 dollars and discounted to 2009 using a real discount rate of 7 percent (required by the TIGER grant application guidelines).<sup>4</sup> The costs are also discounted to present value. The Benefit Cost Ratio is the discounted benefits divided by the discounted costs. If the Benefit Cost Ratio is greater than 1, the project would result in an increase in national income.

The BCA does not consider who the ultimate beneficiaries of the shipping cost reductions and other benefits might be, or who pays the cost of the project. In this case however there is a strong argument for public funding of the costs since the Port of Anchorage (POA) is a “destination port” for almost all of the goods for the entire South Central region rather than a “business port” engaged in the transshipment of goods in competition with other ports. Although not among the largest ports in the nation in terms of tonnage, it is probably more critical to the market it serves than virtually any other port due to the lack of viable alternatives for moving goods into South Central Alaska.

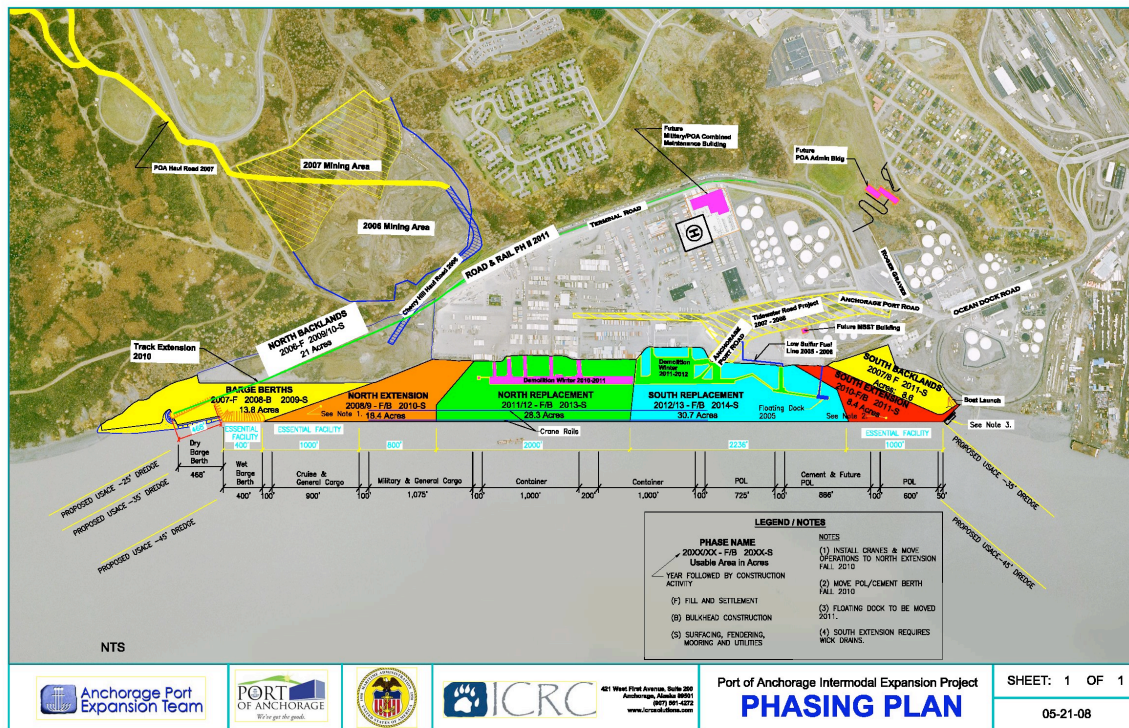
The benefits we quantify are the cost savings associated with completion of two important components of the overall PIEP (which has already been underway for several years)—the NORTH REPLACEMENT and the SOUTH EXTENSION (Figure 3.1.). The TIGER grant funds would be used to pay for large portions of the cost of building the NORTH EXTENSION and the SOUTH EXTENSION. Although the NORTH EXTENSION will ultimately be used for other purposes, its completion is necessary for the NORTH REPLACEMENT to move forward. The NORTH REPLACEMENT will expand the container capacity of the port and also allow larger, more cost efficient, container ships to use the port. The SOUTH EXTENSION will increase the capacity of the port to handle movements of petroleum products. Both components will reduce operations and maintenance costs for the port.

---

<sup>4</sup> Federal Register, 2009



**Figure 3.1. Anchorage Port Inter-modal Expansion Program Phasing Plan**



The primary benefits flowing from the completion of the NORTH REPLACEMENT and SOUTH EXTENSION can be summarized as follows:

- Adding sufficient capacity at the port to allow for growth in demand
- Creating a port able to withstand earthquakes without substantial annual maintenance
- Developing port facilities that allow shippers and others to optimize the efficiency of their operations

The COST in the benefit cost analysis is the \$226 million in TIGER grant funds. These funds would pay most of the cost of the NORTH EXTENSION and the SOUTH EXTENSION.

Other funds would be needed to complete these components as well as the NORTH REPLACEMENT. Thus one might argue that the full benefits of the NORTH REPLACEMENT (container shipping) and SOUTH EXTENSION (petroleum) should not be allocated to the TIGER grant funds. The rationale for full attribution is that without the TIGER grant funds the project would not move forward so all the benefits are contingent on use of those funds. ( In section 7 we conduct sensitivity analysis of this benefit attribution assumption.)

The BCA is contained in an excel spreadsheet which has been posted to the ISER website available at <http://www.iser.uaa.alaska.edu/>.

## 4. Benefit Calculation

We have quantified only three categories of benefits from attributable to TIGER grant funds. They are the benefits associated with capacity expansion, reduced life cycle costs of port maintenance, and increased efficiencies in shipping and handling of freight. These are the most easily identifiable and quantifiable benefits since they can be estimated based on the actual and projected costs associated with port and shipper operations. These benefits will all be reflected in savings to shippers, the port, and customers—the households and businesses in Alaska. As such they represent real increases in national income.

We were, however, unable to quantify all the benefits in these categories due to time and other constraints. For example the cost savings from increased operating efficiencies are largely limited to fuel savings in this analysis and only partially take into account reductions in unit labor costs associated with larger container vessels and reduced cargo handling.

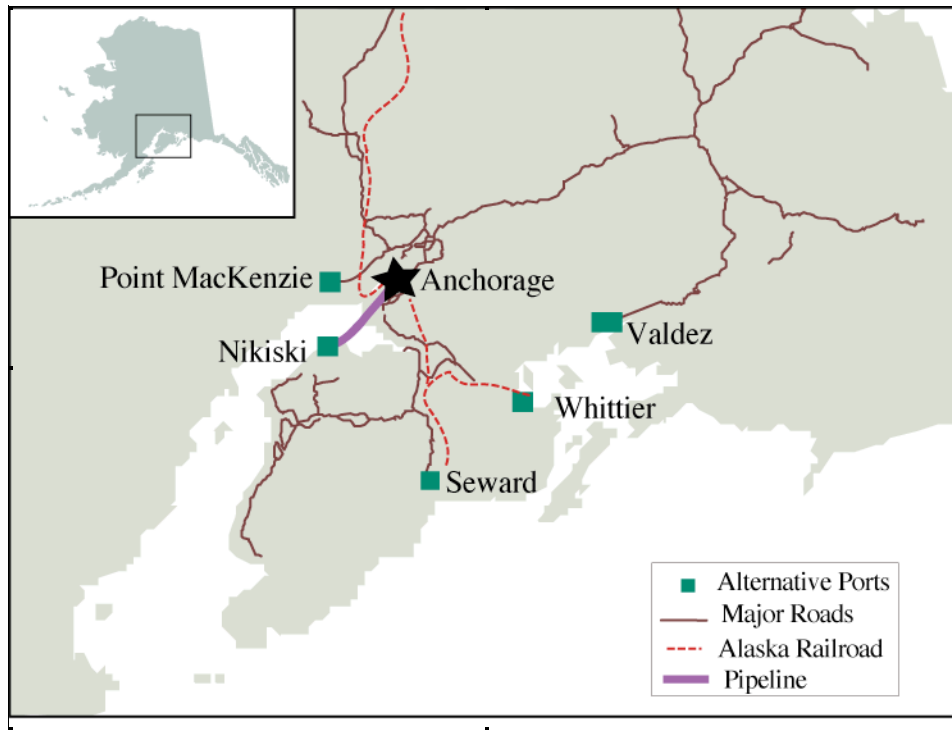
With the exception of the value of reduced CO<sub>2</sub>, NO<sub>x</sub>, and particulate emissions, which are incorporated into the benefit calculations associated with capacity expansion and increased efficiencies (but separately reported below), we have not quantified any of the other port expansion benefits that could generally be characterized as social benefits. These benefits which are generally not reflected in market prices are more difficult to quantify. We discuss them separately in the final section of this report. Their absence means that our quantitative benefit calculation and the resulting benefit cost ratio are smaller than would be the case if we could quantify and monetize all the social benefits of the port expansion.

### 4.a. Capacity Expansion

Since Alaska has a very small manufacturing sector, virtually all producer and consumer goods must be imported from outside the state. The port of Anchorage (POA) is the primary “destination” port for the South Central Alaska as well as much of Northern and Western Alaska—an area of roughly 600 thousand square miles with a population a less than 600 thousand. It handles roughly 90 percent of the freight coming into all of Alaska except the South East panhandle. In addition, a large share of the petroleum consumed in the state also moves through the port.

The role of the POA in the economy is critical because there are no alternatives to the services that the port provides. The other South Central ports are all located at a significant distance from the greater Anchorage area which is the center of population and commerce for the state and the nexus of demand for port services. (Map 4.1)

**MAP 4.1. South Central Alaska Showing Major Ports**



These other ports have limited dock, storage, and crane facilities. Because of the distance, lack of facilities, and additional handling costs for shipping goods to Anchorage through these other ports, very little freight destined for South Central Alaska comes in through these ports. Table 4.1. summarizes the important characteristics of these other ports.

**Table 4.1 Characteristics of South Central Alaska Ports**

Port	Primary Functions	Distance from Anchorage (Miles)	Transport Mode to Anchorage	Acres	Cranes	Dock Length	Petroleum Capacity (mill gal)
Anchorage				160	2 Container Cranes	2,600	118.7
Whittier	Rail Barge	62	Rail	230	Fork lift	350	.048
Seward	Commodity Export	110	Rail / Road	310	2	1,725	1.8
Valdez	Regional Needs	303	Road	21	2	1,500	7.4
Point McKenzie	Commodity Export	87 (partially unpaved)	Road	8,900	1	1,200	None
Nikiski	Petroleum Import	17 (undersea pipeline)	Pipeline	?	-	?	?

A very limited amount of freight comes into South Central Alaska either by air through Ted Stevens Anchorage International Airport or by truck via the Alaska Highway. The expense of air

cargo limits the former to very high value and low weight commodities. The slow delivery time and expense of the latter limits shipments over the highway.

As the Alaska economy continues to expand, and activity continues to concentrate in the greater Anchorage region, demand for port services will continue to grow. This will put increasing pressure on the aging port infrastructure.

The 1999 Regional Port of Anchorage Master Plan<sup>5</sup> analyzed port capacity in 6 dimensions including berth availability, cargo transfer at the wharf apron, apron to storage transfer, storage year and dwell times, storage to inland transfer, and gate processing. Computer modeling was employed to identify two capacity measures. The first was Maximum Practical Capacity (MPC) representing the peak operational level that could be attained for short periods of time. The second was Sustainable Practical Capacity (SPC). Sustained operation above the SPC would be uneconomic and unsafe. The construction of additional terminals or the expansion of existing ones would be appropriate under those circumstances.

The analysis is summarized in Table 4.2 for the main categories of activity at the POA. The summary shows that at that time the port containerized cargo operations were at the sustainable practical capacity (SPC) level. Based on that analysis and projected future growth of the economy, the report projected a need for one new container terminal by 2005 and a second by 2020.

**Table 4.2 Anchorage Port Capacity Analysis (Short tons)**

	Maximum Practical Capacity (MPC)	Sustainable Practical Capacity (SPC)	Actual (1998)	Ratio of Actual to SPC
Containerized Cargo	2,125	1,594	1,572	99%
Liquid Bulk	3,705	2,779	1,280	46%
Dry Bulk	110		96	
Break Bulk	68		0	
Automobiles	39		37	
Cruise Vessels	17	12.83	13	100%

Source: VZM (Vickerman Zachary Miller/ Transsystems). 1999. Regional Port of Anchorage Master Plan

The port capacity conclusions based on the SPC measures were further substantiated by two additional analyses in the same report. The first was based on a comparison of the actual performance of the POA to world standards for container throughput per acre. This analysis found that the actual throughput in 1998 of 5,249 TEUs per acre was at the high end of the range of other ports (2,000-4,500). The second was based on a berth occupancy analysis defined as berth utilization divided by berth availability. This was compared to the Maximum Practical

---

<sup>5</sup> VZM (Vickerman Zachary Miller/ Transsystems). 1999. Regional Port of Anchorage Master Plan

Berth Occupancy (MPBO) which is a measure of the maximum practical berth usage taking into account seasonality, waiting time, tides, weather, first rights agreements for use of facilities, and other variables. The conclusions of this analysis were consistent in concluding that there was a need to expand the port. Furthermore this analysis showed there were times during the year when both the container terminals and the petroleum terminals exceeded the MPBO. The number of “congestion occurrences” in 1998 (MPBO exceeded) was 84.

Actual port experience since that study has also demonstrated the need for additional facilities to meet the growth in demand which has exceeded the projections made in 1998.<sup>6</sup> The 1999 Master Plan conclusions were also underscored in the 2005 Marine Terminal Redevelopment Environmental Assessment EIS.<sup>7</sup>

Operations above capacity result in delays, deterioration of service, congestion, diversions to other ports, and increases in accidents. All of these increase the cost of shipping. Neither the 1999 Master Plan nor the 2005 Marine Terminal Redevelopment Environmental Assessment EIS attempted to quantify the future incidence of these effects or their cost.<sup>8</sup> Nor did they project how freight would get into South Central Alaska if the Port of Anchorage were unable to handle the growing demand.

In this study we develop a model for how freight destined for South Central Alaska and petroleum shipments would be diverted to other ports and modes in a NO BUILD SCENARIO when growing demand can no longer be accommodated at the POA because of capacity constraints. Diversions increase the cost of delivering goods into Anchorage because of additional transportation costs associated with truck and rail transport compared to direct marine transport as well as additional handling costs from transferring goods from ships to trucks or rail.

The basis for estimating these costs is the recent Port of Anchorage Transportation Cost Comparison Study<sup>9</sup> which compares the cost of shipping goods from Tacoma to Anchorage by every mode and through every South Central port. (The only alternative not considered in that study is the cost of air freight.)

The cost associated with diversion of freight to other ports and modes is an approximation of an actual cost effective accommodation of demand growth under the NO BUILD SCENARIO that takes into account all the factors mentioned above which are impossible to project in detail (deterioration in service, incidence of accidents, etc.). It does not consider the cost of incremental investments at the POA or at other South Central Ports to reduce congestion or increase capacity that would either reduce diversion or its cost.

---

<sup>6</sup> Memo from Stuart Greydanus, Director of Operations, Port of Anchorage.

<sup>7</sup> POA (Port of Anchorage). 2005. Marine Terminal Redevelopment Environmental Assessment, EIS.

<sup>8</sup> POA 2005 Marine Terminal Redevelopment EIS does include a section describing the No Action Alternative which is similar to our NO BUILD SCENARIO.

<sup>9</sup> NEI. 2008. Port of Anchorage Transportation Cost Comparison Study. Prepared for Anchorage Economic Development Corporation.

The growth of demand is assumed to be 2.5 percent annually for all South Central ports. This is consistent with the historical growth for the POA over the last decade which averaged 2.7 percent annually.<sup>10</sup> Eventually in the NO BUILD SCENARIO this growth rate results in other South Central ports facing their own capacity constraints from the combination of their own demand growth and incremental demand diverted from Anchorage. This leads to further diversions and eventually the incremental freight must be shipped to Anchorage from Tacoma via the Alcan highway.

The largest uses of the port are the handling of containers and petroleum which together have accounted for about 95 percent of total tonnage in recent years. In this analysis we concentrate on these two port functions, but recognize that constraints associated with these functions can “spill over” and impact the movement of bulk commodities like cement and other goods that have to share facilities with containers and petroleum such as pipe and supplies for construction of a gas pipeline or for development of production facilities for oil and gas on the North Slope of Alaska.

#### *4.a.1. Containers*

The two container freight carriers calling at the POA are Horizon, a lift-on lift-off operation, and TOTE (Totem Ocean Trailer Express) which is a roll-on roll-off carrier. Both carriers service POA from Tacoma, Washington and share about 50 percent of the POA container tonnage. Because of their operating characteristics, TOTE and Horizon have a limited capacity to shift their operations to other South Central ports.<sup>11</sup>

The ports of Seward, Valdez, and Whittier are primarily constrained by the availability of lack of large cranes and backland for container storage.<sup>12</sup> In contrast, the Point MacKenzie Port is primarily constrained by infrastructure to facilitate loading and unloading.<sup>13</sup>

We assume TOTE ships could only be diverted to Point MacKenzie as it is the only port with the capacity to handle roll-on roll-off trucks. Containers would move from the port into Anchorage by truck. When capacity at that port was reached, additional containers would be shipped by barge from Tacoma to Whittier, a much slower alternative. When capacity was reached at Whittier, which has limited backland available for handling containers, the incremental containers would be trucked from Tacoma to Anchorage.

---

<sup>10</sup> POA. 2009. Port of Anchorage Annual Tonnage. Available at: <http://www.muni.org/Departments/port/Documents/AnnualTonnage.pdf>

<sup>11</sup> NEI (2008)

<sup>12</sup> We estimate port capacity based on the acreage available for container storage (based on interviews and NEI, 2008) and the SPC-tonnage per acre in VZM (1999). Due to growth in demand in the alternative ports, the model considers diminishing marginal port capacity over time. Port capacity is a function of throughput, in other words the total of inbound and outbound freight.

<sup>13</sup> We calculate its capacity based on the number of port calls serviceable annually, vessel capacity, and the estimated loading and unloading time stated in NEI (2008).

Horizon would be able to divert to the ports of Seward and Valdez. From Seward 50 percent of the goods might come into Anchorage by rail and 50 percent by truck. Goods arriving through Valdez would all be trucked to Anchorage. Once Seward reached capacity, goods would be shipped through Valdez. Once Valdez reached capacity containers would be trucked from Tacoma to Anchorage.

The container diversion cost is equal to the number of inbound containers measured in TEU (twenty foot equivalent units) times half the transportation cost per FEU (forty foot equivalent units) reported in the transportation cost comparison study (Table 4.3).<sup>14</sup>

**Table 4.3. Transportation Cost per Container: Tacoma to Anchorage (TEU)**

Origin	Destination	Mode	Mode Cost	Total Cost
Tacoma	Anchorage	water	\$ 2,691	\$ 2,691
Tacoma	MacKenzie	water	\$ 2,675	
MacKenzie	Anchorage	truck	\$ 201	\$ 2,876
Tacoma	Seward	water	\$ 2,705	
Seward	Anchorage	rail	\$ 300	\$ 3,005
Tacoma	Seward	water	\$ 2,705	
Seward	Anchorage	truck	\$ 332	\$ 3,037
Tacoma	Valdez	water	\$ 2,693	
Valdez	Anchorage	truck	\$ 819	\$ 3,512
Tacoma	Anchorage	truck	\$ 3,918	\$3,918
Tacoma	Whittier	water	\$ 1,750	
Whittier	Anchorage	rail	\$ 200	\$ 1,950

Source: Northern Economics (2008).

The undiscounted cost savings from container capacity expansion is \$14 million in 2010 growing to \$71 million by 2029. The cumulative savings is \$811 million with a present value of \$362 million in 2009 dollars.

<sup>14</sup> TEU refers to Twenty foot Equivalent Unit while FEU is Fortyfoot Equivalent Unit. One FEU equals two TEUs. The transportation costs in that study are based on a fuel oil cost of \$3.84 per gallon of diesel fuel in 2008. We adjusted the costs downward based on the Energy Information Agency 2009 projections of diesel fuel prices which average \$3.51 over the next 20 years.

Expansion of the container dock would reduce constraints on other uses of the dock such as the movement of military supplies and personnel. We have not included any estimate of the benefits from this in our quantitative analysis.

#### *4.a.2. Petroleum Products*

Petroleum products move through the POA by marine carrier from Washington state and a refinery at Valdez, pipeline from the petroleum port at Nikiski, and railroad from the refinery at North Pole outside Fairbanks. From the POA it is then distributed throughout South Central and Western Alaska, including Ted Stevens International Airport and various military bases, by marine carriers, pipelines, and truck.

It is difficult to get an accurate picture of the volumes of petroleum moving through the port by origin, destination, and mode of shipment because of confidentiality concerns. Based on information from the port we have developed the following description about movements by the 4 operators—Tesoro Petroleum, Aircraft Service International Group (ASIG), Chevron, and Flint Hills.<sup>15</sup>

Inbound fuel movement at POA:

- Tesoro receives the majority of its fuel from their refinery in Nikiski (by pipeline), from the Petro Star's refinery in Valdez (by barge), from Flint Hill's refinery in North Pole (by rail car), and from outside imports. We assume 75 percent comes from Nikiski and equal amounts from the other sources.
- Chevron imports fuel through the POA facility from outside Alaska and from Petro Star's refinery in Valdez (both by barge). We assume 50 percent is imported from outside Alaska and 50 percent comes from Valdez.
- Flint Hills receives the main portion of its fuel from their refinery in North Pole (by rail car) and also fuel from the refinery in Nikiski (by pipeline). We assume 95 percent of their fuel originates in North Pole and 5 percent in Nikiski.
- ASIG receives a third of its fuel from Tesoro's refinery in Nikiski via pipeline and the remainder comes from fuel shipments and fuel purchases from Chevron and Flint Hills. We assume equal amounts originate from all three sources.

Outbound fuel movement at POA:

- The majority of Tesoro's fuel is sold locally but fuel also is shipped to Western Alaska. We assume half goes to each destination.
- Chevron sells its fuel locally and to the Department of Defense (Elmendorf Air Force Base, etc.). We assume equal amounts for both destinations.
- Flint Hills ships its fuel by barge to Western Alaska. It also supplies jet fuel for Ted Stevens Anchorage International Airport (TSAIA) and sells some of its fuel locally. We

---

<sup>15</sup> POA, 2008



assume 40 percent goes to TSAIA, 30 percent to local gas stations, and 30 percent is sold to Western Alaska.

- ASIG provides all its fuel to TSAIA.

We estimate diversion of traffic in the NO BUILD SCENARIO would only impact marine transport of petroleum products. In other words the constraint on the movement of petroleum occurs over the dock but not on the railroad, pipeline, or road.

Over time demand for marine transport of fuel at the POA grows at a faster rate than overall demand because the supply of petroleum products coming into the port by rail from North Pole is projected to decline. This is because the North Pole refinery relies on a declining source of crude oil from the North Slope of Alaska. We assume this source of petroleum products falls at an annual rate of 2 percent. Consequently a larger share of petroleum products will need to come into Anchorage by pipeline and marine transport in the future.

Diversions in the NO BUILD SCENARIO are made primarily to the port of Seward, and to a lesser extent Valdez. Shipments inbound to South Central Alaska would be diverted to Seward and moved by rail to Anchorage or diverted to Valdez and moved by truck to Anchorage. Shipments outbound from Anchorage to Western Alaska would be diverted to Seward and from there by barge (Table 4.4.).

**Table 4.4. Movements of Petroleum Product through POA**

Type	% of Type Total	Status Quo	Alternative - Diversion
Inbound	20%	Nikiski - POA (pipeline)	Nikiski - POA (pipeline)
	24%	North Pole - POA (rail)	North Pole - POA (rail)
	20%	Valdez - POA (water)	Valdez - POA (truck)
	36%	Outside - POA (water)	Outside - Seward (water) - POA (rail)
Outbound	30%	POA - road system (truck)	POA - road system (truck)
	4%	POA - Elmendorf Airforce (pipeline)	POA - Elmendorf Airforce (pipeline)
	40%	POA - ANC airport (pipeline)	POA - ANC airport (pipeline)
	26%	POA - Western AK (water)	POA - Seward (rail) - Western AK (water)

Fuel is predominately transported by barge in Alaska and we calculate the cost per barge load based on cost estimates in the Port of Anchorage Consolidation and Distribution Concept Feasibility Study.<sup>16</sup> For shipments to Western Alaska we assume Unmiak Pass to be the reference point. We calculate transportation costs for petroleum products moved by trucks and the rail road based on the cost of moving a container (Table 4.5.).<sup>17</sup>

**Table 4.5. Transportation Cost for Petroleum Products**

<sup>16</sup> NEI, 2006

<sup>17</sup> We assume that a double truck load equal to 21,000 gallons is equivalent to transporting 2 FEU containers.

Origin	Destination	Mode	Cost per truck load*	Cost per barge load**
Valdez	Anchorage	water		\$ 46,441
Seward	Anchorage	water		\$ 32,931
Seward	Anchorage	rail	\$1,200	
Seward	Anchorage	truck	\$400	
Anchorage	Unimak Pass	water		\$ 82,990
Seward	Unimak Pass	water		\$ 78,648

Source: Northern Economics (2008) and (2006).

\* Based on container cost as a proxy for the transportation cost for petroleum. 2 FEU = 1 double tanker truck = 69 short tons of petroleum product.

\*\* Based on barge transportation costs. 1 barge load = 13,860 short tons

There is no cost savings from expansion of petroleum handling capacity until 2014. Thereafter it grows to \$8 million in 2029. The cumulative savings is \$60 million with a present value of \$22 million in 2009 dollars.

Expansion of the petroleum dock would reduce constraints on other uses of the dock such as the off loading of cement. We have not included any estimate of the benefits from this in our quantitative analysis.

#### **4.b. Reduced Life Cycle Costs**

The existing port has exceeded its design life by many years, and if not replaced, will require significant deferred maintenance and continuing and increasing annual upkeep to keep it operational. The pilings are deteriorating and require replacement, and dredging between the pilings is necessary to minimize damage in the event of an earthquake.<sup>18, 19</sup> Furthermore, immediate storm drainage repair will be necessary if the new port is not constructed since this work has been postponed on the assumption that new port construction will eliminate its need. But at best these expenditures would only prevent further deterioration of the existing port. It would remain susceptible to obsolescence and significant damage if not total destruction in the event of an earthquake.

These costs have been estimated by the port engineer to be \$138 million over the next 20 years, or about \$7 million per year. 1400 piles would need to be repaired in the next 15 years at a cost of \$108,000 per pile. 98,000 cubic yards of material would need to be dredged at a cost of \$2.5 million every ten years. Immediate drainage repairs would cost \$9 million.<sup>20</sup>

<sup>18</sup> R&M Engineering Consultants, Seismic Vulnerability Memorandum, 2009.

<sup>19</sup> POA 2005 EIS. See the No-Action Alternative description.

<sup>20</sup> Cowles, Todd, POA Engineer, 2009

The present value of these costs is \$87 million and they would not be incurred if the new port were constructed. This savings of \$87 million is a benefit of new port construction.

Although there would be other sources of savings associated with development of the new port—like reduced energy costs due to more efficient cranes, we have not quantified them, but rather assumed, conservatively, that the normal operations and maintenance costs of the new port would be approximately the same as the existing port.

#### **4.c. Enhanced Operating Efficiencies**

##### **4.c.1. Larger Container Ship Access**

The increased container dock length would accommodate longer vessels with a greater capacity than currently can use the POA. In addition to adding capacity at the port this would also increase shipping efficiency and reduce the cost of container shipping because of the economies of scale in fuel consumption and manpower associated with the longer or “stretched” ships.

We calculate the benefits associated with being able to accommodate larger ships based on the value of the fuel and labor saved, net of the capital cost to stretch the existing vessels<sup>21</sup>. According to TOTE, a stretched ship would be able to transport 40 percent more load using no additional fuel. (While the fuel efficiency is assumed to be at 468 ton-miles/gallon pre-extension the stretching of the ships would raise the fuel efficiency to 656 ton-miles/gallon of fuel.) If the POA development were to proceed, TOTE would bring stretched ships online in 2015.<sup>22</sup> Nassco, builder of the TOTE vessels, estimates the cost of stretching a ship to be about \$27.5 million. We assume the cost of capital to 8.1% (high risk - LIBOR + ~200 bps) and that the investment is amortized over 20 years.<sup>23</sup>

We assume HORIZON would have the same cost for stretching its ships, the same savings in fuel and manpower, and would convert to stretched ships at the same time.

There would be some other costs and benefits from these conversions, but these would be small in relation to the long term savings from longer ships. TOTE would get some logistical benefits from a better layout of its lot for storing containers. TOTE would have to invest in some new ramps, and HORIZON would have to invest in new, larger cranes.

The total undiscounted savings from access by larger container ships would be \$78 million with a present value of \$43 million.

---

<sup>21</sup> Fuel volume based on transport between Tacoma and Anchorage.

<sup>22</sup> TOTE, 2009

<sup>23</sup> Nassco, 2009 and [http://nreionline.com/mag/real\\_estate\\_miniperms\\_highrisk\\_financing/](http://nreionline.com/mag/real_estate_miniperms_highrisk_financing/)

#### ***4.c.2. Rail Extension***

Extension of the existing rail line to the container terminal would increase the efficiency of the movement by rail of containers destined for Fairbanks by reducing transfer costs and fuel consumption. We approximate the cost savings as the reduction in fuel consumption by truck net of the increase in rail fuel consumption. Savings in labor costs are not included in this estimate.

The undiscounted cost savings from the rail extension is \$1.2 million annually. The cumulative savings is \$25 million with a present value of \$13 million in 2009 dollars.

#### ***4.d. Reduced CO<sub>2</sub> and Other Emissions***

The value from reduced emissions of CO<sub>2</sub>, NO<sub>x</sub>, and particulates as a result of reduced fuel consumption in the BUILD SCENARIO is included in the calculations of the capacity expansion and enhanced operating efficiencies benefits.

Total diesel fuel saved over the 20 year period is 329.3 million gallons. This includes the savings because container and petroleum traffic are not diverted to longer and less fuel efficient routes. The more efficient operation of the container vessels and the transfer of containers to railcars also reduces fuel consumption. The reduction in CO<sub>2</sub> is 809,248 metric tons. The reduction in other emissions, measured only for the savings from reduced truck traffic, is 64.9 tons for NO<sub>x</sub> and 3.2 tons for particulate matter. (Table 6.3).<sup>24</sup>

The calculation of the social value of reduced carbon emissions is based on the EPA estimate of 10.1 kg of CO<sub>2</sub> per gallon of diesel fuel combusted.<sup>25</sup> As required in the TIGER grant application, we use the assumption of \$33 per metric ton of CO<sub>2</sub> emissions, increasing annually at 2.4%.<sup>26</sup> The present value of reduced carbon emission is \$18.8 million.

We estimated the emissions of particulate matter (PM) and NO<sub>x</sub> related to truck traffic but not marine traffic because EPA only regulates these emissions for heavy-duty trucks and not for marine vessels or rail roads. EPA estimates 0.4 grams of NO<sub>x</sub> per vehicle mile and 0.02 grams of PM per vehicle mile.<sup>27</sup> According to U.S. Department of Transportation, the cost per ton of PM is \$168,000 and \$4,000 per ton of NO<sub>x</sub>.

The present value of reducing these emission is modest. The savings from emissions of particulate matter is \$.249 million and from NO<sub>x</sub> it is \$.119 million.

---

<sup>24</sup> Our model includes the following transportation modes: water, rail, and truck transport for which we calculate the total CO<sub>2</sub> emissions.

<sup>25</sup> EPA\_a, 2009

<sup>26</sup> Federal Register, 2009, and USDOT, 2009.

<sup>27</sup> EPA b, 2009.

**Table 4.6. Reduced Emissions Savings**

	<b>CO<sub>2</sub> (all modes)</b>	<b>NO<sub>x</sub> (trucks)</b>	<b>Particulate Matter (trucks)</b>
Metric Tons	809,248	64.9	3.2
Present value (Million \$)	\$18.8	\$119	\$249

## 5. Cost Calculation

The TIGER grant share of the total projected Port Inter-modal Expansion Program (PIEP) expenditures through 2012 are shown in Table 5.1. Of the total of \$421 million, the TIGER grant would fund \$226.6 million during 2010 and 2011. This total of \$226.6 million is the cost used in the benefit cost analysis. The net present value of these expenditures discounted to 2009 is \$208 million.

**Table 5.1 Total Project Projected Expenditures 2009-2012 (Million \$)**

	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>Total</b>
Tiger Funding	-	\$171.2	\$55.5	-	\$226.6
Other Funding	\$39.9	\$22.5	\$74.8	\$57.2	\$194.4
Total Funding	\$39.9	\$193.7	\$130.3	\$57.2	\$421.0

## 6. Results

The cumulative benefits between 2010 and 2029 from construction funded by the Tiger grant is estimated to be \$1.112 billion in 2009 dollars (Table 6.1). The present value of this stream of benefits discounted at 7 percent would be \$527 million. Cumulative costs would be \$226 million, which discounted at 7 percent would have a present value of \$208 million. The net present value of the TIGER grant funding would be \$319 million, the difference between the benefits and the cost (\$527 million minus \$208 million). The ratio of benefits to cost would be 2.5 (\$527 million divided by \$208 million), clearly demonstrating that the project would increase net national income.

The important assumptions in this calculation are as follows:

- Discount rate: 7%
- Annual growth in demand: 2.5%
- Social Cost of Carbon (SCC): \$33/metric ton
- Annual growth in SCC: 2.4%
- Life of the project: 20 years
- Cost of fuel: based on Energy Information Agency, 2009 projection

**Table 6.1. Long Term Economic Benefits Contained in Benefit Cost Analysis**

Long Term Outcome	Port Development Benefit Category	Cumulative Benefits 2010-2029 (Million 2009 \$)	
		Total	Present Value in 2009 Discounted at 7%
TOTAL		\$1,112	\$527
(i) State of Good Repair	Reduction in annual maintenance cost to port (life cycle costs)	\$138	\$87
(ii) Economic Competitiveness	Access by larger container ships and reduced freight handling costs	\$103	\$56
(iii) Livability	Enhancement of port capacity reduces business and household costs	\$871	\$383
(iv) Sustainability	*	-	-
(v) Safety	**	-	-

\* Value of reduced fuel consumption and co2 emissions included in outcomes (ii) and (iii).

\*\* Value of reduced loss in the event of an earthquake included as a sensitivity analysis.

**Table 6.2. The Benefit Cost Ratio Calculation (Million 2009 \$)**

(a ) Long Term Economic Benefits	\$527
(b) Project Cost *	\$208
Net Present Value (a-b)	\$319
Benefit / Cost Ratio (a/b)	2.5

\* Project Expenditures that would occur in 2010 and 2011 are discounted to 2009.



## 7. Sensitivity Analysis

### 7.a. Model Assumptions

We tested the robustness of the Benefit Cost calculation to variation in several model assumptions. The Benefit Cost Ratio of 2.5 was only sensitive to variation in the annual growth rate in regional demand for shipped goods and petroleum. Table 7.1 shows that with a low growth rate assumption of 1 percent the Benefit Cost Ratio falls to 1.6 and the net present value of the project falls to \$126 million. If the assumption is increased to 5 percent, the Benefit Cost Ratio increases to 5.8 with a project net present value of \$993 million.

**Table 7.1. Benefit Cost Ratio Sensitivity to Demand Growth Assumption**

<b>Annual Growth Rate</b>	<b>Net Present Value (Million \$)</b>	<b>Benefit Cost Ratio</b>
1.0%	\$126	1.6
<b>2.5%</b>	<b>\$319</b>	<b>2.5</b>
5.0%	\$993	5.8

Table 7.2. shows that increasing or decreasing the price of fuel oil by 25 percent only changes the Benefit Cost ratio within the range of 2.4 to 2.7.

**Table 7.2. Benefit Cost Ratio Sensitivity to Fuel Price Assumption**

<b>Price</b>	<b>Net Present Value (Million \$)</b>	<b>Benefit Cost Ratio</b>
+25%	\$357	2.7
<b>Base case</b>	<b>\$319</b>	<b>2.5</b>
-25%	\$282	2.4

If the decline in petroleum production, and consequently the movement of refined products by rail from North Pole to the Port of Anchorage, is assumed to be 10 percent annually, the Benefit Cost Ratio increases slightly to 2.6 because of an increase in the diversion of marine petroleum shipments out of Anchorage.

**Table 7.3. Benefit Cost Ratio Sensitivity to Alaska Petroleum Refinery Throughput Assumption**

<b>Annual Decline Rate</b>	<b>Net Present Value (Million \$)</b>	<b>Benefit Cost Ratio</b>
<b>2.0%</b>	<b>\$319</b>	<b>2.5</b>
10.0%	\$331	2.6

Table 7.4. shows that a value of \$2 per metric ton of CO<sub>2</sub> lowers the net present value of the project slightly to \$302 million and the Benefit Cost Ratio to 2.4. If we apply the global value of \$80 per metric ton, the net present value of the project would increase to \$346 million and the Benefit Cost Ratio would increase to 2.7.

**Table 7.4. Benefit Cost Ratio Sensitivity to Social Cost of Carbon Assumption**

<b>Initial Year Price</b>	<b>Net Present Value (Million \$)</b>	<b>Benefit Cost Ratio</b>
\$2	\$302	2.4
<b>\$33</b>	<b>\$319</b>	<b>2.5</b>
\$80	\$346	2.7

### **7.b. Project Cost**

Although the TIGER grant request of \$226.6 million was used to calculate the Benefit Cost Ratio (BCA), we can also form a BCA using other measures of project cost. Table 7.5 shows the Port Inter-modal Expansion Program (PIEP) projected expenditures between 2009 and 2012. Including non TIGER expenditures of \$194 million, total expenditures for the 4 year period, including funds already spent in 2009 would be \$421 million with a present value in 2009 of \$381. Expenditures for the three year period of 2010 through 2012 would be \$381 million with a present value in 2009 of \$341 million. Total expenditures for the two years during which the TIGER grant funds would be expended would be \$324 million with a present value in 2009 of \$295 million.

**Table 7.5. Total PIEP Projected Expenditures 2009-2012 (Million \$)**

	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>TOTAL</b>		
					<b>2010-2011</b>	<b>2010-2012</b>	<b>2009-2012</b>
TIGER Grant	-	\$171.2	\$55.5	-	\$ 226.7	\$226.6	\$226.6
Other Funding Required	\$39.9	\$22.5	\$74.8	\$57.2	\$ 97.3	\$154.5	\$194.4
Total Funding	<b>\$39.9</b>	<b>\$193.7</b>	<b>\$130.3</b>	<b>\$57.2</b>	\$324.0	\$381.1	\$421.0
Present Value					<b>\$294.8</b>	<b>\$341.4</b>	<b>\$381.3</b>

Using in turn each of the present value cost figures in Table 7.5., lower Benefit Cost Ratios result (Table 7.6), but these ratios clearly underestimate project attractiveness. This is because the benefit figure of \$527 million excludes those benefits clearly associated with non TIGER funding that have not been quantified in this study.

**Table 7.6. Total Project Projected Expenditures 2009-2012 (Million \$)**

	<b>PIEP Expenditures 2010-2011</b>	<b>PIEP Expenditures 2010-2012</b>	<b>PIEP Expenditures 2009-2012</b>
Benefits	\$527	\$527	\$527
Costs	\$295	\$341	\$381
Benefit Cost Ratio	1.8	1.5	1.4

Another way to consider the TIGER grant benefits would be to calculate an incremental Benefit Cost ratio based on the notion of the additional benefits from the TIGER grant compared to further development of the port without the grant. It might be that in the absence of TIGER funding the port would still be able to generate some benefits from the expenditure of the non TIGER grant funds shown in Table 7.5. If half the quantified benefits--\$264 million (\$527 million divided by 2)--could be obtained from these non TIGER grant funds, then the Benefit to Cost Ratio of the TIGER grant funds would be 1.3 (\$264 million / \$208 million). However there is no way to determine if all the non TIGER grant funds will actually be available, how they might be spent if the PIEP had to be downsized, and consequently what share of the benefits we have measured could be attained from the the expenditure of non TIGER funds.

### **7.c. Special Large Projects**

A number of large resource development projects are anticipated to occur over the next 10-20 years that would put a large short term incremental demand on the port of Anchorage as well as other South Central ports, both directly as a result of the movement of materials and supplies, and indirectly as a result of population increases associated with those developments. Construction of a gas line and development of a new mine together could generate demand of 5.5 million tons over a several year period in direct supplies alone. With that assumption, the net present value of the project would increase to \$456 million and the Benefit Cost Ratio would increase to 3.2.

**Table 7.7. Benefit Cost Ratio Sensitivity to Special Large Project Demand**

	<b>Net Present Value (Million \$)</b>	<b>Benefit Cost Ratio</b>
Base case	<b>\$319</b>	<b>2.5</b>
Add natural gas and mining development	\$456	3.2

### **7.d. Discount Rate**

If the discount rate used in the analysis were raised to 10 percent to reflect greater risk regarding the future benefits stream, the net present value of the project would fall to \$206 million and the Benefit Cost Ratio to 2.0. If a lower discount rate of 3 percent were used, the Benefit Cost Ratio would be 3.6.

**Table 7.8. Benefit Cost Ratio Sensitivity to Discount Rate**

<b>Discount Rate</b>	<b>Net Present Value (Million \$)</b>	<b>Benefit Cost Ratio</b>
3%	\$786	3.6
<b>7%</b>	<b>\$319</b>	<b>2.5</b>
10%	\$206	2.0

### **7.e. Earthquake Risk Reduction**

Anchorage is located in an active seismic region. During the 1964 earthquake which had its epicenter 75 miles east of Anchorage and had a magnitude of 9.2 making it the largest event ever recorded in North America, most of the ports in South Central Alaska were destroyed. Fortunately the small port at Anchorage was still serviceable, demonstrating the value and necessity of marine access into the region in the event of a natural disaster.

The port of Anchorage, which moves most goods into South Central Alaska, is currently susceptible to earthquake damage and its loss after such a disaster would have a devastating effect on the population and economy. The PIEP would significantly reduce the vulnerability of the port to earthquake damage. This reliability is particularly important for Alaska because of its distance from the rest of the US, challenging climate, and the limited alternatives for moving freight to and within the state. Unlike other places there is an absence of redundancy in the transportation network in Alaska. Consequently it is critically important that the Port of Anchorage continue to function under all circumstances associated with tides, ice, other weather conditions, and most critically, earthquakes.

To investigate the potential benefits of improved reliability that a new port would provide we recast the benefit analysis as a probability analysis. We assumed that in each future year in the NO BUILD SCENARIO there were two possible outcomes. (There was only one BUILD SCENARIO because with PEIP we assume the port could survive any earthquake.) The first would be the “no earthquake alternative” that would have the same benefits as already described. The second would be an earthquake large enough to damage the port sufficiently that it would be out of service for a year while it was rebuilt (“earthquake alternative”). During that time all freight destined for South Central Alaska would have to be diverted to other ports (assumed to be able to continue in operation). The diversion of all freight would last for a year while the port of Anchorage was being rebuilt and this would be a significant increase in the cost of shipping all goods during that time. The rebuilding of the port would be up to the standard represented by the current PIEP proposal rather than simply to replace the current facility. We estimate the cost of reconstruction to be equal to the funding provided by the TIGER grant. After that time the benefits of expanded capacity, reduced life cycle costs, and enhanced operations efficiencies in the BUILD SCENARIO would occur in the “earthquake alternative” scenario.

Of course it is impossible not only to forecast the occurrence of an earthquake and the physical damage that would result, it is also impossible to estimate all the costs such an event could entail. We mention but do not quantify several other obvious categories of costs as follows:

- Mobilization (what is the cost of mobilizing the fleet of trucks and drivers etc. to meet the increased demand)
- Operation (what is the cost of moving a single container to its destination by the alternative route)
- Congestion (what are the costs due to increased congestion at other ports and on the roads that may be unable to handle the volume of traffic)
- Reconstruction Demand (what is the added cost associated with moving the special reconstruction demand thru the alternative ports rather than the port of Anchorage)

We used data from the earthquake forecasts of the U.S. Geological Survey as the starting point for the probability of the “earthquake alternative” in the NO BUILD SCENARIO. That data allowed us to determine the probability of an earthquake of a given magnitude within a certain distance of Anchorage within a certain time period.<sup>28</sup> We chose ZIP code 99501 for Anchorage and a 20 year time period equal to the time horizon of our Benefit Cost Analysis.

---

<sup>28</sup> USGS, 2009

We converted this data to the probability that the POA would experience Peak Ground Acceleration (PGA)—a measure of shaking in gravity units--above the level that would result in enough damage to the port that it would become inoperable and would need to be rebuilt. Since the USGS forecast does not present PGA values for Anchorage specifically, we calculated PGA based on earthquake magnitude and distance from the epicenter to the port. We closely followed the approach taken in the 2008 report: Site-Specific Probabilistic and Deterministic Seismic Hazard Analysis and Development of Earthquake Ground Motions for the Port of Anchorage Expansion Project, Alaska.<sup>29,30</sup>

The result was a probability distribution for earthquakes impacting the Port of Anchorage at various PGA levels. The port engineers believe the current port could withstand an Operating Level Earthquake (OLE), but would be significantly damaged during a Contingency Level Earthquake (CLE) or a Maximum Considered Earthquake (MCE).<sup>31</sup>

- Operating Level Earthquake (OLE) – PGA: between 0.21g and 0.37g
- Contingency Level Earthquake (CLE) – PGA: between 0.37g and 0.61g
- Maximum Considered Earthquake (MCE) – PGA: greater than 0.61g

Finally we calculated the probabilities shown in Table 7.9, which show that the annual probability of an earthquake that could destroy the existing port (CLE or MCE) is quite small.<sup>32,33</sup>

**Table 7.9. Annual Earthquake Probabilities for Port Sensitivity Analysis**

<b>Earthquake Category</b>	<b>Annual Probability of Occurrence in Anchorage</b>
Below OLE	0.100512563
OLE	0.008284654
CLE	0.001106198
MCE	0.000000000

Using these probabilities we determined that the Benefit Cost Ratio taking into account the possibility of a significant earthquake was 2.5—almost identical to the base case presented in section 6. Of course this is contingent upon the particular scenario of earthquake related costs we assumed. Using a different scenario of costs could produce a very different result.

<sup>29</sup> URS, 2008, page 5-1 and 5-2.

<sup>30</sup> URS, 2008 used Atkinson and Boore (2003), Gregor et al. (2002) and Youngs et al. (1997).

<sup>31</sup> PND Engineers, 2008, page 73

<sup>32</sup> Ibid.

<sup>33</sup> R&M Engineers, 2009

## 8. Other Benefits Not Quantified

Additional economic competitiveness and environmental benefits (livability, sustainability, and safety) were also identified in this analysis, but uncertainty in attributing those benefits to the part of the port expansion funded by the TIGER grant, as well as difficulties in quantifying benefits and monetizing them prevented these other benefits from being included in the quantitative benefit cost calculation.

### ***8.a. Economic Competitiveness***

The most potentially significant of these benefits are those associated with economic competitiveness which we have divided into five categories.

#### ***8.a.1. Enhanced Military Preparedness***

The Port of Anchorage has been designated as a “Strategic Military Seaport”. This designation is assigned to those ports that the Department of Defense utilizes for the quick movement of military equipment and personnel overseas in times of crisis, and for the Department of the Army’s Military Surface and Distribution Command. The Port of Anchorage serves Fort Richardson, Elmendorf Air Force Base, Fort Wainwright, Eielson Air Force Base, and Fort Greely. The port is also the gateway to the largest training ground in the US in the interior of the state.

Expanding the capacity of the port will allow the military to move men and materials more expeditiously without interference or delays caused by competing uses of facilities. Since the value of military preparedness is not subject to a market test, it is difficult to put a monetary value on the military willingness to pay for this enhanced capacity.

#### ***8.a.2. Reduced Costs for Alaska Businesses and Residents***

Virtually all consumer goods and business supplies must be shipped to Alaska from the contiguous states, resulting in a higher cost of doing business and a higher cost of living in Alaska than elsewhere. These higher costs reduce the profitability of developing the natural resources of the state—petroleum, seafood, timber, minerals—compared to other locations in the U.S. and abroad. Lowering shipping costs can enhance the competitiveness of some of these businesses. This could result in production increases in Alaska that are not offset by reductions in economic activity in other locations. The result is a real increase in national income rather

than a diversion. Enhanced resource production could also lead to a reduction in imports from abroad which has a positive value in terms of the balance of trade.<sup>34</sup>

It is very difficult to attribute specific increases in natural resource production to changes in a single factor such as a reduction in shipping costs for supplies (or reduction in labor costs due to cheaper consumer goods). However lower business costs clearly do have some stimulative effect.

In the NO BUILD SCENARIO shipping costs would increase because of the diversion of traffic. In the BUILD SCENARIO they would fall because of the savings in port maintenance costs and enhanced efficiencies for shipping operations. The additional tonnage stimulated to move through the port by the drop in shipping cost would be the basis for estimating the national income benefits of the BUILD SCENARIO.

### *8.a.3. Reduced Transport Cost for Special Projects*

A number of large economic development projects have been identified as potential sources of incremental demand on the capacity of the port in the coming years. The most significant example is the construction of a gas pipeline to bring North Slope natural gas to market in the upper Midwest. The steel pipe for the line would weight 3.6 million tons and the project would require 1 million tons of materials. The population growth associated with that project would further add to port demand.

By way of contrast in 2008 the port handled a total of 4.4 million tons over the dock of which most was containers and petroleum. Dry bulk and steel was 117 thousand tons. If the Anchorage port did not have the capacity to handle this demand it would have to be diverted at additional cost, to other South Central ports. If that happened it would increase the cost of moving supplies into the state and also the project cost.

Although it is unlikely that the cost of shipping would be the determining factor in whether any of these special large projects moves forward, it does impact their profitability, and consequently national income. As an example, one of our sensitivity analyses concluded that two special projects—gas pipeline construction and development of a mine—would benefit by \$137 million (discounted at 7 percent) from lower shipping costs in the BUILD SCENARIO (although those savings might not all be attributable to spending of the TIGER grant funds).

### *8.a.4. New Economic Initiatives: Cruise Ships*

Historically only a small number of cruise ships have called at the port of Anchorage during each summer tourist season. However the growing attractiveness of shorter cruises that could start and end in Anchorage, combined with the expanded capacity of the port in the BUILD SCENARIO, could result in an increase in cruise ship traffic. This would result in increased

---

<sup>34</sup> This is described at the “catalytic effect” of port investment in “Port Investment, Profitability, Economic Impact and Financing” by Enrico Musso et al, in Port Economics, ed by Kevin Cullinane and Wayne Talley, Elsevier < Oxford, 2006.



business and job opportunities not only directly but also from the shore based excursions of these visitors.

However many of these visitors are likely to be diverted from some other tourist destination, so it would be inappropriate to include all of any increase in the tourism industry to port expansion. Furthermore, the facilities that would be funded by the TIGER grant would not necessarily be used for cruise ships. Nonetheless under some circumstances this new economic initiative could represent an increase in national income attributable to the TIGER grant.

#### ***8.a.5. New Economic Initiatives: Conbulk Backhaul***

This is a possible initiative based on the observation that most containers return from Anchorage to Tacoma empty and the cost of shipping bulk commodities out of Alaska, like coal being shipped to Korea, is high partly because those ships return to Alaska empty. Special ships capable of carrying both containers and bulk commodities--conbulk ships--could potentially address both problems at once.

These ships would operate between the Far East and the US west coast through Anchorage. One possible configuration would be to carry full containers from Tacoma to Anchorage and bulk commodities from Alaska to the Far East. On the return the ship would either bring bulk commodities or full containers to the US.

This initiative has not advanced beyond the early discussion stage, and its implementation would face very significant challenges. Consequently we do not think it would be appropriate to include as a benefit, although it is worthy of mention because if it could be implemented, it could have a real impact on shipping costs and national income.

### ***8.b. Environmental Benefits***

#### ***8.b.1. Livability: Reduced Highway Congestion***

Expansion of capacity at the Port of Anchorage would eliminate the need to move containerized freight into Anchorage from outlying ports by road. The road connections between these other ports and Anchorage are all paved, except for Point MacKenzie where the first approximately 20 miles is currently not paved. More importantly portions of all of these links consist of two lane highways. The highways from Valdez and Seward also cross mountain ranges. Traffic in the summer on these roads can be extremely crowded, particularly on the weekends. In the winter movement can be restricted by snow and often avalanches.

Even assuming a truck would haul 4 TEU containers, the number of diverted trips would be large because containers would be moving in both directions. As an example, in the year 2020 there would be 32 thousand trips between Point MacKenzie and Anchorage, 16 thousand trips between Valdez and Anchorage, and 8 thousand trips between Seward and Anchorage. In total Anchorage would absorb 56 thousand trips per year.

Without detailed modeling of the road systems in and between these communities, it is not possible to quantify the congestion that would result from these additional trips. It is also not possible to monetize the effects of congestion on other users of the highway system in the form of additional travel costs.

However, because the number of trips would be large, even a very small cost in additional travel time for others on the road system would add up to a very significant total economic loss.

### *8.b.2. Sustainability—Reduced Water Pollution*

We have not attempted to identify or monetize any saving from reduced water pollution in the BUILD SCENARIO since the amount appears to be modest. For example, the new petroleum dock would have larger hoses that would reduce the likelihood of a petroleum products spill. The sheet pile structure of the new dock would allow utilities to be buried rather than exposed under the dock deck. This would minimize the water pollution from a liquid spill from a pipe.

### *8.b.3. Safety—Reduced Highway Accidents, Personal Injuries, and Deaths*

Without additional capacity at the Port of Anchorage, the additional truck traffic on the highway system would lead to an increase in accidents, personal injuries, and deaths. We have not estimated the likely incidence of these events or their cost to society, but it is safe to assume there would be costs stemming from increased accidents during the next 20 years. In 2020 for example the number of miles traveled by truck among South Central communities hauling containers would be about 9 million.

## References

- Alaska Marine Lines. 2009. Personal communication
- Atkinson and Boore. 2003. Empirical Ground Motion Relations for Subduction Zone Earthquakes and Their Application to Cascadia and Other Regions. *Bulletin of the Seismological Society of America*, Vol. 93, No. 4, pp: 1703-1729.
- Campbell, Harry F. and Richard P.C. Brown, Benefit-cost Analysis: Financial and Economic Appraisal using Spreadsheets. Cambridge University Press, Cambridge, 2003.
- EIA (Energy Information Administration). 2009. Petroleum Product Prices. Report #:DOE/EIA-0383(2009) Table 12. Petroleum Product Prices
- Environmental Protection Agency\_a. 2009. Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel. Available at: <http://www.epa.gov/OMS/climate/420f05001.htm#carbon>
- Environmental Protection Agency\_b. 2009. Proposed Standards for Heavy-Duty Highway Engines and Vehicles. Available at: <http://www.epa.gov/otaq/regs/fuels/diesel/f00022.htm#3>
- Federal Register.2009.Notice of Funding Availability for Supplemental Discretionary Grants for Capital Investments in Surface Transportation Infrastructure Under the American Recovery and Reinvestment Act/Vol. 74, No. 115 /Wednesday, June 17, 2009 /Notices, page 28755-28767.
- Google. 2009. Google Earth software. Available at: <http://earth.google.com/>
- Gregor, N.J., Silva, W.J., Wong, I.G., and Youngs, R.R. 2002. Ground-Motion Attenuation Relationships for Cascadia Subduction Zone Megathrust Earthquakes based on a Stochastic Finite-Fault Model. *Bulletin of the Seismological Society of America*, Vol. 92, No. 5, pp: 1923-1932.
- Greydanus, Stuart. Personal communication.
- Hanley, Nick and Clive L Spash. Cost Benefit Analysis and the Environment. Edward Elgar, Northampton, 1993.
- Morgan, M. Granger, and Max Henrion. Uncertainty: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis. Cambridge University Press, Cambridge, 1990.
- Musso, Enrico, Claudio Ferrari and Mrco Benacchio. "Port Investment: Profitability, Economic Impact and Financing" in Port Economics, edited by Kevin Cullinane and Wayne Talley, Elsevier, Oxford, 2006.

Nassco. 2009. Personal communication.

Northern Economics Inc. 2006. Port of Anchorage Consolidation and Distribution Concept Feasibility Study. Prepared for Anchorage Economic Development Corporation.

Northern Economics Inc. 2008. Port of Anchorage Transportation Cost Comparison Study. Prepared for Anchorage Economic Development Corporation.

Okuyama, Yasuhide and Stephanie E. Chang, editors. Modeling Spatial and Economic Impacts of Disasters. Springer-Verlag, Berlin, 2004.

PND Engineers. 2008. Port of Anchorage Marine Terminal Redevelopment Geotechnical Analysis Report

POA (Port of Anchorage). 2005. Marine Terminal Redevelopment Environmental Assessment, EIS.

Privratsky, Ken, Letter to Alaska Legislature regarding Port of Anchorage funding, March 20, 2008.

R&M Engineers. 2009. Communication about POA susceptibility to earthquake damage.

TOTE. 2009. Personal communication.

URS. 2008. Site-Specific Probabilistic and deterministic seismic hazard analysis and development of earthquake ground motions for the Port of Anchorage Expansion Project, Alaska

USDOT. 2009. Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light trucks: Final Regulatory Impact Analysis. Available at:  
[http://www.nhtsa.dot.gov/portal/nhtsa\\_static\\_file\\_downloader.jsp?file=/staticfiles/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE\\_Final\\_Rule\\_MY2011\\_FRIA.pdf](http://www.nhtsa.dot.gov/portal/nhtsa_static_file_downloader.jsp?file=/staticfiles/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_Final_Rule_MY2011_FRIA.pdf)

U.S. Department of Energy. 2009. Transportation Indicators. available at:  
[http://www1.eere.energy.gov/ba/pba/intensityindicators/docs/transportation\\_indicators.xls](http://www1.eere.energy.gov/ba/pba/intensityindicators/docs/transportation_indicators.xls)

USGS. 2009. 2002 Earthquake Probability Maps. Available at:  
<http://earthquake.usgs.gov/eqcenter/shakemap/images/scale.jpg>

POA. 2009. Port of Anchorage Annual Tonnage. Available at:  
<http://www.muni.org/Departments/port/Documents/AnnualTonnage.pdf>

TOTE (Totem Ocean Trailer Express). 2009. TOTE ships Orca class. Available at:  
<http://www.totemocean.com/ts-ships.htm>

VZM (Vickerman Zachary Miller/ Transsystems). 1999. Regional Port of Anchorage Master Plan

Youngs, R.R., Chiou, S.-J., and Silva, W.J. 1997. Strong Ground Motion Attenuation Relationships for Subduction Zone Earthquakes. *Seismological Research Letters*, Vol. 68, 1, pp: 58-73.

## **Appendix: Excel Workbook**

The Benefit Cost Analysis is contained in an Excel workbook that is available on the website of the Institute of Social and Economic Research of the University of Alaska Anchorage. It can be accessed at <http://www.iser.uaa.alaska.edu/>